AMS Assignment 1 R codes

Xiao Changrong

September 17, 2019

```r
# Exercise 1
x1 = c(1, 4, 1, 3, 2, -6)
x2 = c(-1, 5, 2, 4, 1, -1)
x3 = c(-1, 5, 1, 0, -1, 3)
# a
print(2 * x1 - x2 + x3)
```

```
## [1]  2  8  1  2  2 -8
```

```r
# b
# i
print(x1 %*% x2)
```

```
##      [,1]
## [1,]   41
```

```r
# ii
print(x2 %*% x3)
```

```
##      [,1]
## [1,]   24
```

```r
# iii
print(x1 %*% x3)
```

```
##      [,1]
## [1,]    0
```

```r
# c
print(x1 %o% x2)
```

```
##      [,1] [,2] [,3] [,4] [,5] [,6]
## [1,]   -1    5    2    4    1   -1
## [2,]   -4   20    8   16    4   -4
## [3,]   -1    5    2    4    1   -1
## [4,]   -3   15    6   12    3   -3
## [5,]   -2   10    4    8    2   -2
## [6,]    6  -30  -12  -24   -6    6
```

```r
#d
print(sqrt(sum(x1 ^ 2)))
```

```
## [1] 8.185353
```

```r
print(sqrt(sum(x2 ^ 2)))
```

```
## [1] 6.928203
```

```r
print(sqrt(sum(x3 ^ 2)))
```

```
## [1] 6.082763
```

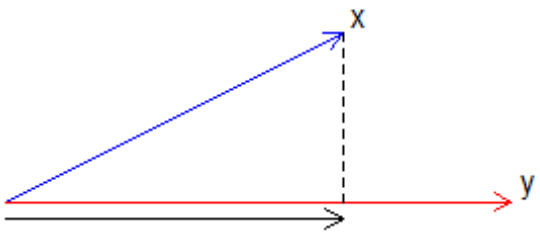
```r
# e
# i
print(((x2 %*% x1) / (x2 %*% x2)) * x2)
```

```
## [1] -0.8541667  4.2708333  1.7083333  3.4166667  0.8541667 -0.854166
7
```

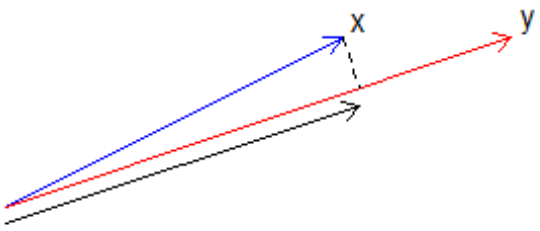
```r
# ii
print(((x3 %*% x1) / (x3 %*% x3)) * x3)
```

```
## [1] 0 0 0 0 0 0
```

```r
# Exercise 3
draw_vectors = function(X1, Y1, X2, Y2) {
    x = 0
    y = 0
    x1 = X1
    y1 = Y1
    x2 = X2
    y2 = Y2
    v1 = c(x1, y1)
    v2 = c(x2, y2)
    plot(x, y, xlim = c(0, 4), ylim = c(-0.2, 1.2), type = "n", axes =
FALSE, frame.plot = FALSE, ann = FALSE, asp = 1)
    arrows(x, y, x1, y1, length = 0.1, col = "blue")
    text(x1 + 0.1, y1 + 0.1, labels = "x")

    arrows(x, y, x2, y2, length = 0.1, col = "red")
    text(x2 + 0.1, y2 + 0.1, labels = "y")

    v3 = ((v2 %*% v1) / (v2 %*% v2)) * v2
    arrows(x, y - 0.1, v3[1], v3[2] - 0.1, length = 0.1)
    lines(c(x1, v3[1]), c(y1, v3[2]), lty = 2)
}

draw_vectors(2, 1, 3, 0)
```




```
draw_vectors(2, 1, 3, 1)
```



```r
# Exercise 4
m1 = matrix(c(3, 2, 1, 0, 2, 1, -1, 4, 3), 3, 3)
m2 = matrix(c(1, 5, 2, 1, -1, 3), 2, 3)
v1 = c(1, 4, 1)
v2 = c(-1, 5, 2)
# i
print(m1 %*% v1)
```

```
##      [,1]
## [1,]    2
## [2,]   14
## [3,]    8
```

```r
# ii
print(m2 %*% v1)
```

```
##      [,1]
## [1,]    8
## [2,]   12
```

```r
# iii
print(v1 %*% m1 %*% v1)
```

```
##      [,1]
## [1,]   66
```

```r
# iv
print(m2 %*% m1)
```

```
##      [,1] [,2] [,3]
## [1,]    6    3    4
## [2,]   20    5    8
```

```r
# v
print(t(m1) %*% m1)
```

```
##      [,1] [,2] [,3]
## [1,]   14    5    8
## [2,]    5    5   11
## [3,]    8   11   26
```

```r
# vi
print(t(m2) %*% m2)
```

```
##      [,1] [,2] [,3]
## [1,]   26    7   14
## [2,]    7    5    1
## [3,]   14    1   10
```

```r
# vii
print(m1 %*% t(m1))
```

```
##      [,1] [,2] [,3]
## [1,]   10    2    0
## [2,]    2   24   16
## [3,]    0   16   11
```

```
# viii
print(m2 %*% t(m2))
```

```
##      [,1] [,2]
## [1,]    6    4
## [2,]    4   35
```

```
# Exercise 5
A = matrix(c(2, 1, 3, 4, 3, 8, -2, 2, 0, -4, 5, 1, -1, 3, 4, 1), 4, 4)
# a
print(det(A))
```

```
## [1] 238
```

```
# b
m2 = matrix(c(1, 5, 2, 1, -1, 3), 2, 3)
print(det(t(m2) %*% m2))
```

```
## [1] -2.444199e-13
```

```
# c
print(round(solve(A), digits = 4))
```

```
##         [,1]    [,2]    [,3]    [,4]
## [1,] -0.2857 -0.0630 -0.1555  0.5252
## [2,]  0.4286  0.0798  0.1303 -0.3319
## [3,]  0.5714 -0.0210  0.2815 -0.4916
## [4,] -0.2857  0.1134  0.0798  0.0546
```

```
# Exercise 6
x = matrix(c(1, 0, 0, 0, 0, 1), 3, 2)
y = c(1, 3, 2)
print(x %*% solve(t(x) %*% x) %*% t(x) %*% y)
```

```
##      [,1]
## [1,]    1
## [2,]    0
## [3,]    2
```